UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

MAR 0 8 2017

Kimberly Damon-Randall
Assistant Regional Administrator for Protected Resources
National Marine Fisheries Service
1 Blackburn Drive
Gloucester, MA 01930

Dear Ms. Damon-Randall

The U. S. Environmental Protection Agency (EPA) has completed its review of Delaware's revised water quality criteria for copper. On December 26, 2013, the Delaware Department of Natural Resources and Environmental Control (DNREC) published in the Delaware Register proposed revisions to the State's Water Quality Standards (WQS), including revisions to the copper criteria for the protection of aquatic life in freshwaters. DNREC conducted a public hearing on April 29, 2014. EPA reviewed and provided comment to these revisions on May 1, 2014. On October 1, 2014, the Delaware Register published notice of the adoption of the revisions to the State's WQS, including the revised copper criteria, with an effective date of October 11, 2014. EPA received the Delaware WQS Triennial Review package, which included the revised copper criteria, for our approval on November 21, 2014.

EPA first submitted a Biological Evaluation (BE) with a request for concurrence from NMFS on February 6, 2015. In response, your office requested additional information regarding the environmental effects of the new and revised criteria adopted by Delaware. After much discussion between EPA and NMFS, EPA conducted a detailed BE that focused solely on the fresh water Copper Biotic Ligand Model (Cu BLM) criteria and the potential effect of the BLM criteria on Atlantic and Shortnose sturgeon.

EPA prepared the enclosed Biological Evaluation to ensure that an action approving the Cu BLM criteria will not adversely affect Federally-listed threatened and endangered species, and their critical habitat. Based on the findings in the enclosed Biological Evaluation, EPA concludes that Delaware's adoption of these revised aquatic life water quality criteria may affect but are not likely to adversely affect listed species in Delaware. The purpose of this letter is to submit and seek concurrence from the National Marine Fisheries Service on the Biological Evaluation. We look forward to your reply and a favorable response to your review of the provided information. We request that you provide a response within thirty (30) of receipt of this letter.

Should you have any questions concerning this correspondence or the enclosure, please contact me at (215)814-5707 or Mark Barath of my staff at (215)814-2759.

Sincerely,

Evelyn MacKnight

Evelyn MacKnight, Associate Director
Office of Standards, Assessment & Total Maximum Daily Load

Enclosure

Cc. Christine Vaccaro (NMFS)

Informal Biological Evaluation Pertaining to:

Approval of Delaware Department of Natural Resources and Environmental Control Copper Biotic Ligand Model Water Quality Standard

EPA Region III
Clean Water Act Section 303(c)(3)

March 2017

Introduction:

Under Section 303(c) of the Clean Water Act (CWA) and 40 CFR 131, States and authorized tribes have primary responsibility for developing and adopting Water Quality Standards (WQS) to protect their waters. As required by Section 303(c) of the CWA and 40 CFR 131, the U.S. Environmental Protection Agency (EPA) reviews new and revised surface WQS that have been adopted by States and authorized tribes. State WQS are not considered effective under the CWA until approved by EPA.

This Biological Evaluation (BE) relates specifically to Delaware's adoption of EPA's 2007 nationally recommended copper criteria for freshwaters: the freshwater Copper Biotic Ligand Model (Cu BLM) ambient water quality criteria (2007) to protect aquatic life in State of Delaware freshwaters (excluding those freshwaters regulated by the Delaware River Bay Commission [DRBC; e.g., the main stem of the Delaware River). EPA is consulting with the U. S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) on the revised State of Delaware aquatic life criteria, as required under Section 7 of the Endangered Species Act (ESA). The agencies agree that it is prudent to examine the aquatic life criteria for protection of listed species and critical habitat, and realize the importance of conducting the consultations on proposed and/or revised state criteria so states can adopt aquatic life criteria that are protective of the listed species within the state.

In February 2015, EPA and NMFS exchanged email correspondence to provide a preliminary description of the proposed action and action area as well as collaborate with NMFS to initially identify listed species of concern that may be adversely affected by approval of the 2007 Cu BLM in the State of Delaware freshwaters. In a letter dated March 27, 2015, FWS concurred with EPA's Not Likely to Adversely Affect (NLAA) determination as it relates to species under FWS jurisdiction in a BE submitted to the FWS on February 6, 2015. Ongoing discussion between EPA and NMFS staff have proved invaluable and EPA thanks NMFS staff for providing insight that directly supported the development of this BE.

Federal Action:

The Federal action being evaluated in this BE is the approval by the EPA of a new provision set forth in the State of Delaware Department of Natural Resources and Environmental Control (DNREC) Administrative Code Title 7401 Surface Water Quality Standards. This new provision of the regulations, which have been established to protect public health, welfare and enhance water quality in Delaware, was initially proposed by Delaware on December 26, 2013, together with other changes. In 2013, DNREC announced that proposed changes to water quality standards would be published in the Delaware Register of Regulations, Issue Date: January 1, 2014 Volume 17 - Issue 7, 7 Delaware Code, Section 6010 (7 Del.C. §6010) 7 DE Admin. Code 7401 REGISTER NOTICE. The proposed amendments were published in the DELAWARE REGISTER OF REGULATIONS, VOL. 18, ISSUE 4, WEDNESDAY, OCTOBER 1, 2014, pages 312-316 DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL DIVISION OF WATERSHED STEWARDSHIP Statutory Authority: 7 Delaware Code, Section 6010 (7 Del.C. §6010) 7 DE Admin. Code 7401 Secretary's Order No. 2014-WS-

0019. Final adoption by Delaware of the changes was certified by the Delaware Office of the Attorney General in a letter dated October 22, 2014.

Delaware has adopted the following regulatory language for copper: (Table 1)

Table 1. *State of Delaware Water Quality Standard Revised Criterion for Copper.*

Parameter	Fresh Acute Criterion	Fresh Chronic Criterion
Copper	Freshwater criteria calculated using the EPA Biotic Ligand Model	Freshwater criteria calculated using the EPA Biotic Ligand Model

The acute criterion above will be applied as 1-hour average concentrations not to be exceeded more than once in three years on average. The chronic criterion will be applied as a four-day average concentration not to be exceeded more than once in three years on average.

The toxicity of copper to an aquatic organism requires the transfer of copper from the external environment to biochemical receptors on or in the organism at which the toxic effects are elicited. Often, this transfer is not proportional to the total copper concentration in the environment, but varies according to physiochemical conditions of the exposure environment to influence bioavailability and consequently, copper toxicity. For example, dissolved copper commonly complexes with various ligands, including dissolved organic compounds (DOC), hydroxides, carbonates, and other inorganic ligands. As a result of copper complexion with ligands *in situ*, total or particulate copper concentrations are sometimes poor predictors of Cu bioavailability and toxicity (King et al. 2010).

The revision to the freshwater copper aquatic life criteria that Delaware has adopted applies to all freshwaters with a salinity less than 1 parts per thousand (ppt) and is based on a copper magnitude (criteria concentration) identical to the existing EPA 304(a) recommendations (EPA 2007). This revision to the copper criteria recommendation replaces the 1984 hardness-based criteria with the 2007 biotic ligand model (metal bioavailability model) that uses receiving waterbody characteristics to develop site-specific criteria that are more accurate than the 1984 hardness-based criteria. The 2007 Cu BLM incorporates the best available data to understand the effects of ligand complexation on copper bioavailability and to provide a robust conceptual framework for quantifying copper toxicity across a wide-range of exposure conditions. Specifically, the 2007 Cu BLM requires ten input parameters: temperature, pH, dissolved organic carbon, calcium, magnesium, sodium, potassium, sulfate, chloride and alkalinity. Please see Appendix A (EPA 2007) for a further mechanistic description of the 2007 Cu BLM.

The copper criteria would become effective for Clean Water Act purposes (e.g., as the basis for water quality-based effluent limits in NPDES permits and for determining waterbody impairments) from the date of EPA's approval.

Action Area:

EPA's approval of the 2007 Cu BLM in the State of Delaware applies to all freshwaters of the United States within the State. Jurisdiction over non-navigable, isolated, and intrastate waters would likely have to be determined on a case-by-case basis. Waters of the State of Delaware are defined in 7401 Surface Water Quality Standards, 2.0 Definition "Waters of the State" means: All surface waters of the State including, but not limited to: (1) Waters which are subject to the ebb and flow of the tide, including but not limited to estuaries, bays, and the Atlantic Ocean; (2) All interstate waters, including interstate wetlands; (3) All other waters of the State, such as lakes, rivers, streams (including intermittent and ephemeral streams), drainage ditches, tax ditches, creeks, mudflats, sandflats, wetlands, sloughs, or natural or impounded ponds; (4) All impoundments of waters otherwise defined as waters of the State under this definition; (5) Wetlands adjacent to waters (other than waters that are themselves wetlands) identified above; (6) Waste and stormwater treatment systems, including but not limited to treatment ponds or lagoons designed to meet the requirements of the Clean Water Act (other than cooling ponds which otherwise meet the requirements of subsection (l) of this definition) are not waters of the State; (7) Waters of exceptional recreational or ecological significance (ERES): Waters which are important, unique, or sensitive from a recreational and/or ecological perspective, but which may or may not have excellent water quality. Such waters shall normally have regional significance with respect to recreational use (fishing, swimming, and boating), or have significant or widespread riverine, riparian, or wetland natural areas.

Freshwater in the State of Delaware is defined in regulation as waters of the state which contain natural levels of salinity of 5 ppt or less. However, the Delaware River Basin Commission's water quality criteria apply to all the State's tidal tributaries of the Delaware River, regardless of salinity (DRBC 2013). Therefore, the revised copper criteria action will not apply to the mainstem or tidal tributaries of the Delaware River in Delaware. The revised copper criteria will apply to non-tidal segments of tributaries of the Delaware River, in Delaware with salinity < 1 ppt.

NMFS Listed Species in the Action Area:

Communication with NMFS personnel indicated seven initial species of concern that may be affected by the proposed action (Vaccaro, C., personal communication, 2015). As a result, this BE will be limited to the following aquatic species that may potentially occur in the action area: Atlantic sturgeon, shortnose sturgeon, loggerhead turtle, Atlantic ridley turtle, leatherback turtle, green turtle, and hawksbill turtle.

Atlantic Sturgeon:

Atlantic sturgeon (*Acipenser oxyrinchus*) is a federally listed species with distinct population segments (DPSs) found in the Gulf of Maine, New York Bight, and Chesapeake Bay. Atlantic sturgeon was listed as endangered on February 6, 2012 (77 FR 5880). Atlantic sturgeon were once plentiful in the Delaware and Chesapeake Bays with an estimated 20,000 female adults present before the sturgeon fishery began in the 1890s. The Delaware River Atlantic sturgeon fishery was the largest in the United States and produced 75% of the US sturgeon harvest from 1890-1899 (Townsend 1900). By 1901, the fishery collapsed and less than 10% of its 1890 peak landings were reported. The fishery never recovered with harvest remaining at 1-5% of the historic peak. The Atlantic sturgeon fishery was closed in 1998, when a coast-wide fishing moratorium was imposed for 20-40 years, or at least until 20 year classes of mature female Atlantic sturgeon were present.

Historical harvests were reported in the Patuxent, Potomac, Choptank, Nanticoke, and Wicomico/Pocomoke rivers (ASSRT 2007). In 1996, 3,275 yearling hatchery Atlantic sturgeon were stocked in the Nanticoke River. Between 1996 and 2000, 462 hatchery Atlantic sturgeon were collected; the majority were captured in the first two years (Secor et al. 2000). Within eight months post-release, fish doubled in size and were spread throughout Maryland waters of the Chesapeake Bay, from Baltimore Harbor to the lower Potomac River. This stocking exercise showed that the Chesapeake Bay and certain tributaries are capable of supporting yearling and juvenile stocked sturgeon (NMFS 2007). The survival and growth rates of the stocked Atlantic sturgeon suggest the Nanticoke River may contain suitable nursery habitat; however, specific spawning grounds, or spawning occurrence, remain undocumented (NMFS 2007).

Atlantic sturgeon is an anadromous fish which spends most of its adult life in brackish or salt water and migrates to freshwater to spawn. Adults migrate in April and May from the mid-Atlantic to flowing freshwaters, commonly as far upstream as the fall line of large rivers to spawn. Atlantic sturgeon eggs and larvae are salt intolerant and require salinity levels below 0.25 ppt (Van Eenennaam et. al. 1996). As a result, Atlantic sturgeon spawning is believed to occur in flowing waters between salt front and fall line of large rivers, where optimal flows are 46-76 cm/s and depths of 11-27 meters (Borodin 1925, Leland 1968, Scott and Crossman 1973, Crance 1987, Bain et al. 2000).

Documented Atlantic sturgeon spawning grounds remain limited (Appendix B). Following the egg and larval life stages, juvenile Atlantic sturgeon may venture into the lower Delaware River, where juveniles have been captured near Marcus Hook, PA. (Delaware River Keeper 2012). In the Delaware River, information on the location and timing of Atlantic sturgeon spawning in relation to salinity is limited, although believed to occur in a region +/- 32 km bracketing the freshwater/saltwater interface (Ryder 1890). Historical accounts suggest that Atlantic Sturgeon primarily utilized the Delware River between Bombay Hook, DE (river mile 61) and Chester, PA (rm 130; Ryder 1890). Modeling efforts (Breece, et. al., 2013) suggest spawning areas could occur between Claymont, DE and Chester, PA., which are largely composed of bedrock habitat that is ideal for spawning (Breece, et. al., 2013). Appendix B shows the mid-Atlantic region with documented spawning area and accessible waterways (NMFS 2016c).

In 2008, New Jersey Division of Fish and Wildlife suggested Pennsylvania/New Jersey waters near Marcus Hook, PA may serve as habitat for juveniles; however, blasting activities associated with channel deepening may have degraded suitable habitat (NJ DEP 2007). Although Atlantic sturgeon have been documented to briefly enter the C & D canal from the Delaware River Estuary (Brundage and O'Herron 2009), sturgeon spawning is not known to occur in the C & D canal (Park, I., personal communication, 2015).

Spawning adults remain in freshwaters until fall, at which time they migrate back to the Atlantic Ocean, while juveniles are most likely to remain in their natal waters up to six years before migrating to the ocean. Once Atlantic sturgeon reach open saltwater, they typically reside close to shore.

Among the many variables affecting proposed critical habitat or Atlantic sturgeon range are dams, dredging, and blasting. There are no dams in the Delaware River which are below historic spawning reaches. Atlantic sturgeon need clean, hard substrate for attachment of demersal, adhesive eggs (Bushnoe et al. 2005). Rubble, cobble, and gravel size rock, as well as shell, forest litter, and submerged vegetation provide substrate for egg attachment, all which can be affected by dredging operations. Appendix B (NMFS), suggests Atlantic sturgeon spawning occurs in the Delaware River, north of the Delaware/Pennsylvania boarder.

Shortnose Sturgeon:

Shortnose sturgeon (*Acipenser brevirostrum*) is a federally listed species found in both the Delaware River and the Chesapeake Bay. Shortnose sturgeon was listed as endangered on March 11, 1967 under the Endangered Species Preservation Act of 1966. NMFS later assumed jurisdiction for shortnose sturgeon under a 1974 government reorganization plan and it has remained on the endangered species list with the enactment of the Endangered Species Act (ESA) in 1973 (NMFS 1998). Within our action area there are two distinct populations: Delaware River population and the Chesapeake Bay population.

Shortnose sturgeon spend most of their life in their natal river systems, only occasionally entering higher salinity environments such as the tidally-influenced portions of the Delaware River. In populations that have free access to the total length of a river (absent of dams), such as the Delaware River, spawning areas are located at the farthest accessible upstream reach of the river, often starting just below the fall line (NMFS 1998a). Shortnose sturgeon spawn in freshwater habitats and spawn earlier and generally further upriver than Atlantic sturgeon (Bain 1997). Shortnose sturgeon are believed to spawn at discrete sites within a river (Kieffer and Kynard 1993). In the Delaware River, studies indicate that spawning areas are considered to be from Scudder Falls near I-95 bridge to above Fife & Drum rapids (ERC, Inc. 2008). In the Delaware River, adults remain in freshwater all year, but some adults briefly enter low salinity river reaches in May-June, then return upriver (Buckley and Kynard 1985a; Kieffer and Kynard 1993; O'Herron et al. 1993). Males may spawn a maximum of every other year (Dadswell 1979). Females may spawn at a maximum of once every 3 years, with time between spawning being as long as 5 to 11 years (Dadswell 1979). Fertilized eggs are adhesive and demersal (Meehan, 1910). Eggs and yolk-sac larvae may be concentrated near the spawning areas for up to 4 weeks post spawning (NMFS 2010). Distribution of young-of-year (YOY) shortnose sturgeon and Atlantic sturgeon can partially overlap near the freshwater/brackish interface in the Delaware River.

Research suggests shortnose sturgeon may move through all areas of a river system but often remain in important resting and feeding aggregations for extended time periods (Hastings et al. 1987, Kieffer and Kynard 1993). Little is known on YOY behavior; however, YOY shortnose sturgeon remain in channel areas within freshwater habitats upstream of salt wedge until they reach 45 cm, or two to eight years of age (Dadswell et al. 1984). Shortnose sturgeon grow slowly, remaining juveniles until about 45 cm, or age 3 to 10, depending on sex of fish (Dadswell, et al. 1984). No spawning activity has been documented in any of tributaries or main stem of the Chesapeake Bay (NMFS 2010).

Tracking studies indicate the Delaware River may be used as overwintering area by juvenile shortnose sturgeons. Shortnose sturgeon were found to overwinter in the Roebling (rkm 199), Bordentown, (rkm 207) or Trenton reaches from December-March. The channel off Duck Island (rkm 208) is used heavily by overwintering shortnose sturgeon (O'Herron 1993). Acoustic tagging studies indicate the existence of an overwintering area in the lower portion of the river, below Wilmington, DE (ERC, Inc. 2006a). Wintering adults are normally observed in tight aggregations and move minimally. Additionally, results from a preliminary tracking study of juvenile shortnose sturgeon suggest that the entire lower Delaware River, from Philadelphia (~ rkm 161) to below Artificial Island (located in river between Delaware and New Jersey), may be utilized as an overwintering area by juvenile shortnose sturgeon (ERC, Inc. 2007b). According to ERC, Inc. (2007b), juvenile sturgeon in the Delaware River overwinter in a dispersed fashion rather than in dense aggregations like adults. Three individual sturgeon, however, appear to have overwintered downriver, below Wilmington (rkm 113), suggesting the possible existence of an overwintering area in the lower Delaware river; however, previously there had been no evidence of such in the Delaware River (ERC, Inc. 2006a).

Movement patterns observed by ERC (2007b, 2006a) indicate a portion of adult shortnose sturgeon may overwinter in the upper tidal Delaware River and move to the spawning area in the lower non-tidal river in late March and April (ERC, Inc. 2006a). Outside of spawning grounds, acoustic tagging studies by ERC, Inc. (2006a) indicate adult shortnose sturgeon demonstrate one of two generalized movement patterns: long excursions from the upper to the lower tidal river (Pattern A), or remaining in and utilizing the upper tidal river (Pattern B; ERC, Inc. 2006a). Adult shortnose sturgeon with Pattern A movements made long distance excursions, often moving between the upper tidal river and the area of the C & D (rkm 95).

Shortnose sturgeon are benthic omnivores and continuously feed on benthic and epibenthic invertebrates including mollusks, crustaceans, and oligochaetes (Dadswell 1979). Foraging occurs in summer and fall from Trenton (NJ) down to Artificial Island (DE/NJ). It is assumed that a water depth of about 0.6 m is needed for unimpeded swimming by adults (Crance 1986). Radio-tagged adults were tracked during summer in areas where water depths ranged from 1 to 27 m; the fish made extensive use of quiet shallow water (McCleave et al. 1977). During summer, adults forage in shallow areas generally located where salinities range from about 0.5 ppt to 3 ppt (Dadswell et. al, 1984). It should be noted that the C & D Canal is the only current freshwater body in Delaware where adult shortnose sturgeon have been tracked. (DeFriece, J., personal communication, 2015).

Sea Turtles:

Listed sea turtles include the threatened loggerhead turtle (*Caretta caretta*), endangered Kemp's ridley turtle (*Lepidochelys kempi*), endangered leatherback turtle (*Dermochelys coriacea*), endangered hawksbill turtle (*Eretmochelys imbricata*), and threatened green sea turtle (*Chelonia* *mydas*). Threats to sea turtles include incidental take, poaching, ship strikes, and destruction of nesting and feeding grounds. NMFS considers only the Delaware Bay proper and non-Delaware portions of Chesapeake Bay to be the range of sea turtles (Appendix C). This BE pertains specifically to the approval of freshwater (e.g., salinity < 1 ppt) Cu BLM criteria. Because sea turtles do not occur in jurisdictional Delaware freshwaters, further discussion and analysis of sea turtles is limited.

Effect Assessment

Background:

High quality (e.g., 1985 Guidelines acceptable; Stephen et al. 1985) empirical copper toxicity data for shortnose sturgeon or Atlantic sturgeon are relatively limited. As a result, EPA also considered copper toxicity data for surrogate species, toxicity estimation tools (e.g., Acute-Chronic Ratio [ACR]), exposure potential, and previous biological opinions (NMFS 2012; NMFS 2014; FWS 2015) pertaining to sturgeon to determine if listed sturgeon may be adversely affected by the proposed action.

In 2012, NMFS released a biological opinion on EPA's Approval of Revised Water Quality Criteria for Toxic Pollutants in Oregon. NMFS (2012) assessed the sensitivity of salmonids to acute and chronic copper exposure and subsequently directed EPA to "*...promulgate, if necessary...EPA's 2007 BLM-based aquatic life criteria*" to protect listed salmonids (NMFS 2012, Section 2.10.1). In 2014, NMFS also released a biological opinion on EPA's Approval of the State of Idaho's Water Quality Criteria for Toxic Substances (NMFS 2014). Appendix C of the NMFS (2014) biological opinion evaluated the accuracy and protectiveness of EPA's 2007 Cu BLM and concluded that the "*analysis of the performance of the 2007 BLM-based copper criteria tends to be favorable*" and that "*its* (Cu BLM) *application appears to be protective of listed salmon.*" Because NMFS concluded the Cu BLM is protective of salmonids in Oregon (NMFS 2012) and Idaho (NMFS 2014), and rainbow trout (salmonid) serve as robust surrogate species for sturgeon (Dwyer et al. 2005), the U.S. Fish and Wildlife Service subsequently concluded that the 2007 Cu BLM is protective of listed sturgeon in Idaho. Specifically, the U.S. Fish and Wildlife Service stated that "1)*...does not anticipate that additional consultation will be required if the 2007 national recommended aquatic life criteria for copper (freshwater Cu BLM) are adopted...* and 2) *Service agrees with NMFS's reasoning (in NMFS 2014, Appendix C) and conclusion and finds that it is applicable to the Kootenai River white sturgeon and its critical habitat*" (FWS 2015).

Copper Sensitivity Analysis:

The 2007 Cu BLM acute magnitude (concentration) is based on the four most-sensitive genera (i.e., genus mean acute values; GMAV) with these four BLM-normalized[1] toxicity GMAVs ranging from 4.05 µg/L to 9.60 µg/L. When the 2007 Cu BLM was developed, the only high quality acute toxicity data considered for the family *Acipenseridae* was based on shovelnose

[1] Toxicity values were normalized so they are comparable to one another, even though toxicity tests may have been conducted using test waters consisting of different physiochemical parameters (See EPA 2007, Appendix A, Section 3.1).

sturgeon (*Scaphirhynchus platorynchus;* Dwyer et al. 1999), with a normalized GMAV of 69.63 μg/L, which is considered acceptable family-level surrogate toxicity data for both Atlantic and shortnose sturgeon. Dwyer et al. (2000) also conducted 96-hour acute toxicity tests with both Atlantic sturgeon (fry life stage) and shortnose sturgeon (life stage not directly reported, assumed to be fry, which is further suggested by Dwyer et al. [2005]), however, this data was not considered to derive the 2007 Cu BLM. In toxicity test waters (reconstituted hard water), Dwyer et al. (2000) determined Atlantic sturgeon and shortnose sturgeon acute LC_{50} values to be 60 μg/L and 80 μg/L, respectively. Consistent, with the 1985 Guidelines (Stephen et al. 1985), Atlantic and shortnose sturgeon LC_{50} values were adjusted (adjustment factor = 2; LC_{50} to LC_{low} ratio) to result in acute low effect threshold concentrations (relevant to Dwyer et al. [2000] test waters) of 30 μg/L and 40 μg/L, respectively.

EPA considered the physiochemical parameters[2] of Dwyer et al. (2000) test solutions to calculate the acute copper criterion (CMC = 3.45 μg/L) corresponding to the specific test waters Dwyer et al. (2000) used to assess Atlantic sturgeon and shortnose sturgeon sensitivity. The acute low effect threshold for Atlantic sturgeon is 8.7 times greater than the acute criterion and the shortnose sturgeon acute low effect threshold is 11.6 times greater than the acute criterion. Given the nearly order of magnitude difference between the acute criterion concentration and sturgeon acute low effect thresholds, EPA concludes Atlantic sturgeon and shortnose sturgeon adults, juveniles, and fry are not likely to be adversely affected by the acute Cu BLM.

Given data limitations, high-quality chronic sturgeon toxicity data were not used to derive the chronic Cu BLM (2007). The Cu BLM does, however, report a freshwater Final Acute to Chronic Ratio (FACR) of 3.22. The FACR acts as a ratio to relate the acute sensitivity of an organisms to a particular chemical (e.g., copper) to the predicted chronic sensitivity of that organism to the same chemical. Dividing acute effect concentrations (i.e., LC_{50}) by the FACR (3.22) results in a corresponding chronic effect concentrations (i.e., NOEC, EC_{20}, etc.) that can be directly compared to the chronic criterion concentration. Therefore, the chronic effect concentrations for Atlantic sturgeon and shortnose sturgeon, in Dwyer et al. (2000) test waters, are 18.63 and 24.84 μg/L, respectively. The chronic copper criterion (CCC) corresponding to the physiochemical conditions[2] of toxicity test waters is 2.14 μg/L. Because the chronic effect concentrations for Atlantic sturgeon and shortnose sturgeon are 8.7 – 11.6 times greater than the corresponding chronic criterion, EPA concludes Atlantic sturgeon and shortnose sturgeon adults, juveniles, and fry are not likely to be adversely affected by the chronic Cu BLM.

While acute and chronic toxicity data reported here for Atlantic sturgeon, shortnose sturgeon, and shovelnose sturgeon are based primarily on fry sensitivity, more recent data suggest newly-hatched white sturgeon (*Acipenser transmontanus*; genus-level surrogate; 1-24 days post-hatch[dph]), may be more sensitive to chronic copper exposures than fry, juveniles, and adult life stages (Wang et al. 2014, test C1-R). As a result, EPA considered exposure potential to assess the possibility of newly-hatched sturgeon to occur in the State of Delaware freshwaters that are applicable to this proposed action (note, the Delaware River, including portions in Delaware, is

[2] Physiochemical conditions of Dwyer et al. (2000) test waters were obtained from the Cu BLM (2007) criteria document (Appendix E, BLM Data Label = SCPL01S), which outlines test waters used for shovelnose sturgeon reported in (Dwyer et al. 1999). Dwyer et al. (2005) suggested the physiochemical conditions of test waters were equal across Atlantic sturgeon, shortnose sturgeon, and shovelnose sturgeon toxicity tests.

regulated by the Delaware River Basin Commission and is beyond the action area). EPA also considered how the duration and frequency components of the proposed action provide listed sturgeon additional levels of protection (please see *Additional Considerations below*).

Exposure Analysis:

According to the NMFS maps (2016c; Appendix B), the documented spawning area for Atlantic sturgeon in the Delaware Rivers is above river mile 78 in Pennsylvania/New Jersey waters. Adults may often migrate in April and May from the mid-Atlantic to flowing freshwaters, commonly as far upstream as the fall line of large rivers to spawn. Historic spawning grounds were documented to occur in New Jersey waters (NJDEP 2007) and modeling further suggests that suitable spawning grounds exist north of State of Delaware waters in Pennsylvania and New Jersey portions of the Delaware River. Additionally, because eggs and newly hatched sturgeon remain relatively sessile, sensitive life stages are not anticipated to occur in Delaware portions of the Delaware River post-hatch. The NMFS documented spawning area is outside the range of waters in Delaware defined as freshwaters, where newly-hatched Atlantic sturgeon are expected to be found. As a result, the proposed action is expected to have no effect on spawning grounds, eggs, and newly-hatched Atlantic sturgeon in the action area.

Shortnose sturgeon populations with free access to the total length of a river (absent of dams), such as the Delaware River, spawning areas are located at the farthest accessible upstream reach of the river, often starting just below the fall line (NMFS 1998a). For example, shortnose sturgeon spawn in the free flowing, non-tidal Delaware River north of Trenton, NJ, at least 55 river miles upstream of the State of Delaware. Documented spawning locations have not been found to occur in the action area within the State of Delaware (Greco, M. 2015). Generally, shortnose sturgeon spawn further upriver than Atlantic sturgeon (Bain 1997). Additionally, shortnose sturgeon spawning activity has not been documented in any of tributaries to the Chesapeake Bay (NMFS 2010). Furthermore, because early life stages of sturgeon undergo an initial hiding stage after hatching (Wang et al. 2014), early life stages are anticipated to remain in close proximity to spawning grounds in Pennsylvania and New Jersey. The proposed action is, therefore, expected to have no effect on spawning grounds, eggs, and newly-hatched shortnose sturgeon in the action area.

Sea turtles do not occur in the action area (i.e., jurisdictional Delaware freshwaters defined as waters with salinity < 1 ppt) and, therefore, the proposed action will have no effect on listed sea turtle populations

Additional Considerations:

The full definition of the acute and chronic 2007 copper criteria include frequency and duration aspects in addition to magnitude (concentration). Delaware's acute copper criterion specifies a 1-hour (duration) concentration (magnitude) that is not to be exceeded more than once every three years on average (frequency; Stephen et al. 1985). Similarly, the chronic copper criterion specifies a 4-day (duration) concentration that is also not to be exceeded more than once every three years on average (Stephen et al. 1985). Frequency and duration components of criteria are built on conservative assumptions to provide aquatic life, including listed species, with added layers of protection. For example, Delaware's acute copper criterion specifies a 1-hour duration, even though the criterion magnitude (i.e., concentration) is determined through 96-hour continuous exposure toxicity testing. Moreover, the chronic copper criterion specifies a 4-day duration, even though the chronic criterion magnitude is determined from toxicity tests that continuously exposed organisms to copper for 24-60 days (24-60 days represents common exposure durations in chronic toxicity testing). Effect concentrations are inherently linked to exposure duration. The longer organisms are exposed to a particular pollutant, the lower (e.g., organisms appear to be more sensitive) the observed effect concentration typically is. EC_{20} values based on exposure durations that accurately represent the chronic criterion (i.e., 4-days) would typically be greater (e.g., organisms appear to be less sensitive) than the EC_{20} based on 24-day to 60-day exposures, which are typically used to derive chronic criteria magnitudes.

Potential to Adversely Affect Determination:

EPA approval of the acute and chronic Cu criteria (BLM; 2007) will not adversely affect Atlantic sturgeon, shortnose sturgeon, or sea turtles or their critical habitats (Table 2). This criteria update is beneficial to the conservation and protection of aquatic life and aquatic habitats from copper in the jurisdictional freshwaters of the State of Delaware because it represents more current science and is based on a more current toxicity test database than the previous (i.e., 1984) criteria.

Table 2. *Likely to adversely affect decision for each listed species/taxa of concern and the rationale (based on weight of evidence) for each decision.*

Listed Species	Likely to Adversely Affect?	Rationale
Atlantic Sturgeon	No	• Considering listed Kootnai River white sturgeon, FWS (based on NMFS 2012; NMFS 2014) stated, "*The Service does not anticipate that additional consultation will be required if the 2007 national recommended aquatic life criteria or other alternative criteria which would be as protective for copper are adopted by EPA.*" • Surrogate toxicity indicate adult and juvenile sturgeon occurring in the action area are not sensitive to copper at concentrations and exposure durations allowed by the proposed action. • Early life stages may be more sensitive than adult sturgeon; however, exposure analysis indicates early life stages do not occur in the action area.

shortnose Sturgeon	No	• Considering listed Kootnai River white sturgeon, FWS (based on NMFS 2012; NMFS 2014) stated, "*The Service does not anticipate that additional consultation will be required if the 2007 national recommended aquatic life criteria or other alternative criteria which would be as protective for copper are adopted by EPA.*" • Surrogate toxicity indicate adult and juvenile sturgeon occurring in the action area are not sensitive to copper at concentrations and exposure durations allowed by the proposed action. • Early life stages may be more sensitive than adult sturgeon; however, exposure analysis indicates early life stages do not occur in the action area.
sea turtles	No	• Sea turtles do not occur in the action area.

EPA agrees with the U.S. Fish and Wildlife Service (FWS 2015) that the 2007 Cu BLM reflects the latest scientific knowledge and provides protection to ESA listed species in Delaware freshwaters. EPA sincerely thanks NMFS staff for ongoing discussions and insight that was provided to ensure this biological evaluation was developed considering the latest scientific knowledge. EPA also thanks NMFS for assistance in determining particular listed species discussed in this informal BE.

EPA's approval of Cu BLM WQS in Delaware freshwaters may affect, but will not adversely affect Atlantic and shortnose sturgeons. EPA views the copper criteria revision as beneficial to the conservation and protection of aquatic life, including listed aquatic species, and their habitats from copper in the freshwaters of Delaware. EPA recognizes that it may need to revise its decision if this consultation identifies situations where the approved criteria may not be adequate. If this should be the case, EPA will coordinate with the Services to determine a reasonable approach.

References:

ASSRT (Atlantic Sturgeon Status Review Team). 2007. Status Review of Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus). Report to National Marine Fisheries Service, Northeast Regional Office. February 23, 2007. 174 pp.

Bain, M. B. 1997. Atlantic and shortnose sturgeons of the Hudson River: Common and Divergent Life History Attributes. Environmental Biology of Fishes 48: 347-358.

Bain, M. B., Haley, N., Peterson, D., Waldman, J. R. and Arend, K.. 2000. Harvest and habitats of Atlantic Sturgeon Acipenser oxyrinchus Mitchill, 1815, in the Hudson River Estuary: Lessons for Sturgeon Conservation. Instituto Espanol de Oceanografia. Boletin 16: 43-53.

Borodin, N. 1925. Biological Observations on the Atlantic Sturgeon, (Acipenser sturio). Transactions of the American Fisheries Society 55: 184-190.

Breece, M.W., Oliver M.J., Cimino, M.A., Fox, D.A. (2013) Shifting Distributions of Adult Atlantic Sturgeon Amidst Post-Industrialization and Future Impacts in the Delaware River: a Maximum Entropy Approach. PLoS ONE 8(11): e81321. doi:10.1371/journal.pone.0081321

Brundage, H.M. and O'Herron, J.C., 2009. Investigation of juvenile shortnose and Atlantic sturgeons in the lower tidal Delaware River. Bulletin of the New Jersey Academy of Science. 54(2): 1-9.

Buckley, J., and B. Kynard. 1985. Yearly movements of Shortnose Sturgeon in the Connecticut River. Transactions of the American Fisheries Society 114:813-820.

Bushnoe. 2005. Chapter 8, Atlantic Coast Diadromous Fish Habitat: A Review of Utilization, Threats, Recommendations for Conservation, and Research Needs Habitat Management Series #9, Atlantic States Marine Fisheries Commission, January 2009, 489 pp.

Crance, J.H. 1986. Habitat suitability index models and instream flow suitability curves: shortnose sturgeon. U.S. Fish Wildl. Serv. Biol. Rep 82(10.129). 31 pp.

Crance, J. H. 1987. Habitat Suitability Index Curves for Anadromous Fishes. In: Common Strategies of Anadromous and Catadromous Fishes, ed. M. J. Dadswell. Bethesda, Maryland, American Fisheries Society. Symposium 1: 554.

Dadswell, M.. 1984. Synopsis of biological data on shortnose sturgeon, *Acipenser brevirostrum*, LeSueur 1818. National Oceanic and Atmospheric Administration, Washington, D.C., 45pp.

DeFriece, J. 2015. Delaware Dept. of Natural Resources and Environmental Control. Personal communication with M. Barath, United States Environmental Protection Agency, Philadelphia, Pennsylvania.

Delaware River Basin Commission 2013. Administration Manual Part III, Water Quality Regulation, 18 CFR 410 Section 3.30.1 Application, 189 pp.

Delaware River Keeper. 2012. The Atlantic Sturgeon (Acipenser oxyrinchus) of the Delaware River – A Story of Plenty and Decline. Delaware River Keeper Network. Bristol, PA.

Dwyer, F. J., Mayer, F. L., Sappington, L. C., Buckler D. R., Bridges C. M., Greer I. E., Hardesty D. K., Henke, Ingersoll C. G., Kunz, Whites D. W., Augspurger T., Mount D. R., Hattala K., Neuderfer G. N. 2005. Assessing Contaminant Sensitivity of Endangered and Threatened Aquatic Species: Part I. Acute Toxicity of Five Chemicals, Arch. Environ. Contam. Toxicol. 48, 143–154.

EPA. 2007. Ambient Aquatic Life Water Quality Criteria for Copper (February 2007). Office of Water. Washington, D.C. EPA-822-R-07-001

EPA. 2014. Biological Evaluation for the Approval of Maryland Department of the Environment Water Quality Standards by EPA Region III under Clean Water Act Section 303(c)(3). Philadelphia, PA. 45 pp.

ERC, Inc. (Environmental Research and Consulting, Inc.). 2006. Acoustic telemetry study of the movements of Shortnose Sturgeon in the Delaware River and bay progress report for 2003-2004. Prepared for NOAA Fisheries. 11 pp.

ERC, Inc. (Environmental Research and Consulting, Inc.). 2007. Preliminary acoustic tracking study of juvenile Shortnose Sturgeon and Atlantic Sturgeon in the Delaware River. May 2006 through March 2007. Prepared for NOAA Fisheries. 9 pp.

ERC, Inc. (Environmental Research and Consulting, Inc.). 2008. Final report of investigations of shortnose sturgeon early life stages in the Delaware River, spring 2007 and 2008. Prepared for the NJ Division of Fish and Wildlife. 24 pp.

Fish and Wildlife Service, 2015, Biological Opinion for the Idaho Water Quality Standards for Numeric Water Quality Criteria for Toxic Pollutants (draft), U.S. Fish and Wildlife Service, Idaho Fish and Wildlife Office, Boise Idaho pp. 351.

Greco, M. 2015. Personal Communication, Delaware Division of Fish and Wildlife, Little Creek Delaware.

Hastings, R.W., J.C. O'Herron II, K. Schick, and M.A. Lazzari. 1987. Occurrence and distribution of shortnose sturgeon, Acipenser brevirostrum, in the upper tidal Delaware River. Estuaries 10:337-341.

Ingersoll, C.G., and Mebane, C.A., eds., 2014, Acute and chronic sensitivity of white sturgeon (*Acipenser transmontanus*) and rainbow trout (*Oncorhynchus mykiss*) to cadmium, copper, lead, or zinc in laboratory water-only exposures: U.S. Geological Survey Scientific Investigations Report 2013–5204, p. 35–70.

Kieffer, M. C., and B. Kynard. 1993. Annual Movements of Shortnose and Atlantic Sturgeons in the Merrimack River, Massachusetts. Transactions of the American Fisheries Society 122:1088–1103.

King, C. K., Dowse, M. C, Simpson, S. L. 2010, Toxicity of Metals to the Bivalve Tellina deltoidalis and Relationships Between Metal Bioaccumulation and Metal Partitioning Between Seawater and Marine Sediments. Arch Environ Contam Toxicol (2010) 58:657–665.

Leland, J. G., III. 1968. A Survey of the Sturgeon Fishery of South Carolina. Contributions of Bears Bluff Laboratories No. 47. 27 pp.

Little, E. E., R. D. Calfee, G. Linder. 2012. Toxicity of copper to early-life stage Kootenai River white sturgeon, Columbia River white sturgeon, and rainbow trout. Arch Environ Contam Toxicol 63:400-408.

McCleave, J.D., S.M. Fried and A.K. Towt. 1977. Daily movements of shortnose sturgeon, Acipenser brevirostrum, in a Maine estuary. Copeia 1977:149-157.

Meehan, W.E. 1910. Experiments in sturgeon culture. Trans.Am. Fish. Soc. 39:85-91.

New Jersey Department of Environmental Protection. 2007. Delaware River Main Channel Deepening Project, Supplemental Environmental Impact Statement (SEIS) Information.

NOAA National Marine Fisheries Service. 1998. Recovery plan for the shortnose sturgeon Acipenser brevirostrum). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland.

NOAA National Marine Fisheries Service. 2010. A Biological Assessment of shortnose sturgeon (*Acipenser brevirostrum*). Report to National Marine Fisheries Service, Northeast Regional Office. November 1, 2010. 417 pp.

NOAA National Marine Fisheries Service. 2012. Jeopardy and destruction or adverse modification of critical habitat Endangered Species Act biological opinion for Environmental Protection Agency's proposed approval of certain Oregon administrative rules related to revised water quality criteria for toxic pollutants. National Marine Fisheries Service, Northwest Regional Office, NMFS No: 2008/00148. Seattle, Washington. 777 pp.

NOAA National Marine Fisheries Service 2014. Biological Opinion on EPA's Approval of the State of Idaho's Water Quality Criteria for Toxic Substances. National Marine Fisheries Service, Northwest Region, NMFS No: 2000-1484, Boise, Idaho. 528 pp.

NOAA National Marine Fisheries Service. 2014b. An evaluation of the accuracy and protectiveness of EPA's 2007 biotic ligand model (BLM)-based copper criteria for copper [Appendix C.]. Pages 434-502 *in Biological Opinion on EPA's Approval of the State of Idaho's Water Quality Criteria for Toxic Substances*. National Marine Fisheries Service, Northwest Region, Boise, Idaho.

NOAA National Marine Fisheries Service Fisheries. 2016a. Endangered and Threatened Species; Designation of Critical Habitat for the Gulf of Maine, New York Bight, and Chesapeake Bay Distinct Population Segments of Atlantic Sturgeon. 50 CFR Part 226. 150818735-6236-01. Washington, D.C.

NOAA National Marine Fisheries Service Fisheries. 2016b. ESA Listed Species Descriptions. http://www.nmfs.noaa.gov/pr/species/fish/atlantic-salmon.html#documents

NOAA National Marine Fisheries Service Fisheries. 2016c. https://www.greateratlantic.fisheries.noaa.gov/protected/section7/guidance/maps/atlanticsturgeon.pdf.pdf

O'Herron, J.C., K.W. Able, and R.W. Hastings. 1993. Movements of shortnose sturgeon (*Acipenser brevirostrum*) in the Delaware River. Estuaries 16:235-240.

Park, I., 2015. Delaware Division of Fish and Wildlife. Personal communication with M. Barath, United States Environmental Protection Agency, Philadelphia, Pennsylvania.

Ryder, J.A. 1890. The Sturgeon and Sturgeon industries of the eastern coast of the United States, with an account of experiments bearing upon Sturgeon culture. Bulletin of the U.S. Fish Commission (1888) 8: 231-328.

Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada Bulletin 184: 996 pp.

Secor, D.H.; Niklitschek, E.J.; Stevenson, J.T.; Gunderson, T.E.; Minkkinen, S.P.; Richardson, B.; Florence, B.; Mangold, M.; Skjeveland, J.; Henderson-Arzapalo, A. (2000). Dispersal and growth of yearling Atlantic sturgeon, Acipenser oxyrinchus, released into Chesapeake Bay Fish. Bull. 98(4): 800-810

Stephan, C.E., D.I. Mount, D.J. Hansen, J.H. Gentile, G.A. Chapman, and W.A. Brungs. 1985. Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses. PB85-227049. National Technical Information Service, Springfield, VA. 98 pp.

Townsend, C.H. 1900. Statistics of the fisheries of the Middle Atlantic States. Part 26 of the Commissioner's Report to the U.S. Commission of Fish and Fisheries: 195-310.

Van Eenennaam, J. P., S. I. Doroshov, G. P. Moberg, J. G. Watson, D. S. Moore and J. Linares. 1996. Reproductive conditions of the Atlantic Sturgeon (*Acipenser oxyrhynchus*) in the Hudson River. Estuaries 19: 769-777.

Vaccaro, C. 2015. National Marine Fisheries Service. Personal communication with M. Barath, United States Environmental Protection Agency, Philadelphia, Pennsylvania.

Wang, N., Ingersoll, C.G., Dorman, R.A., Kunz, J.L., Hardesty, D.K., Brumbaugh, W.G., and Mebane, C.A., 2014, Chronic sensitivity of white sturgeon (*Acipenser transmontanus*) and rainbow trout (*Oncorhynchus mykiss*) to cadmium, copper, lead, or zinc in laboratory water-only exposures. Environ Toxicol Chem, 33:2246-2258.

Appendix A: Copper Biotic Ligand Model Description (from EPA 2007 Copper criteria document [EPA 2007])

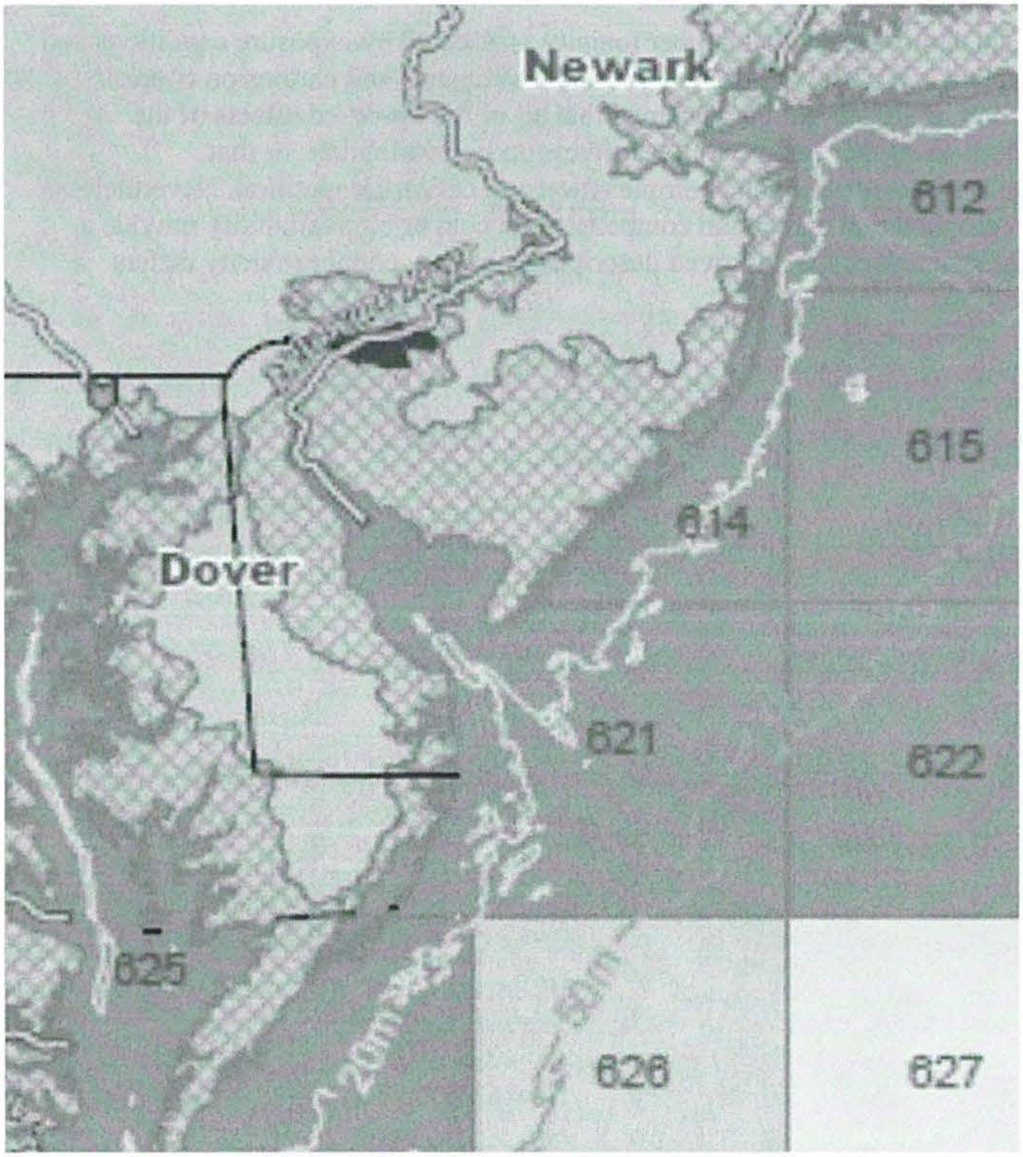
The toxicity of a chemical to an aquatic organism requires the transfer of the chemical from the external environment to biochemical receptors on or in the organism at which the toxic effects are elicited. Often, this transfer is not simply proportional to the total chemical concentration in the environment, but varies according to attributes of the organism, chemical, and exposure environment so that the chemical is more or less "bioavailable". Just knowing the concentration of copper will not provide adequate information regarding its toxicity. Of particular importance to bioavailability is that many chemicals exist in a variety of forms (chemical species). Such chemical speciation affects bioavailability because relative uptake rates can differ among chemical species and the relative concentrations of chemical species can differ among exposure conditions. Most dissolved copper is part of stronger complexes with various ligands (complexing chemicals that interact with metals), including dissolved organic compounds (DOC), hydroxides, carbonates, and other inorganic ligands. Substantial amounts of copper can also be adsorbed to or incorporated into suspended particles but may not be as readily available. Particulate copper concentrations were found to be a poor predictor of Cu bioaccumulation and toxicity (King, Dowse and Simpson, 2010).

Copper toxicity has been reported to vary markedly due to various physicochemical characteristics of the exposure water and their effects on copper toxicity therefore could be due to effects on copper bioavailability. A "ligand" is a complexing chemical (ion, molecule, or molecular group) that interacts with a metal like copper to form a larger complex. A "biotic ligand" is a complexing chemical that is a component of an organism (e.g. chemical site on a fish gill). For certain ligands, some studies have demonstrated that the concentration of free copper associated with a specified level of accumulation or toxicity changes little as the ligand concentration is varied, despite major changes in the proportion of copper bound to the ligand (see review by Campbell, 1995). This suggests that, even at low concentrations, free copper is more important to bioavailability than the ligand-bound copper.

The effects of physicochemical factors on copper toxicity are diverse and the specific chemistry of the exposure water will determine whether or not there are appreciable effects on copper speciation and a resulting strong relationship of toxicity to free copper. Usually copper toxicity is reduced by increased water hardness (reviews by Sprague, 1968; Hunt, 1987; Campbell, 1995; Allen and Hansen, 1996; Paquin et al., 2002), which is composed of cations (primarily calcium and magnesium) that do not directly interact with copper in solution so as to reduce bioavailability. In some cases, the apparent effect of hardness on toxicity might be partly due to complexation of copper by higher concentrations of hydroxide and/or carbonate (increased pH and alkalinity) commonly associated with higher hardness. However, significant effects on toxicity often are still present when hardness is increased in association with anions which do not interact strongly with copper (Inglis and Davis, 1972; Chakoumakos et al., 1979; Miller and Mackay, 1980; Erickson et al., 1987). Hardness cations could have some limited effect on copper speciation by competing with copper for the same dissolved ligands, but increased hardness would then increase free copper and thus increase, not decrease, toxicity. Sodium has also been reported to affect copper toxicity (Erickson et al., 1996 b) and pH effects can be partly due to effects of hydrogen ion other than on copper speciation (Peterson et al., 1984).

The empirical evidence demonstrates that copper toxicity is affected by exposure conditions and that much of these effects is plausibly attributed to effects of ligands and cations on copper bioavailability. However, it should not be presumed that all of the observed effects of the physicochemical factors on copper toxicity reflect effects on bioavailability, or that bioavailability effects are just due to ligand complexation and cation competition. Nevertheless, the effects of ligand complexation and cation competition on copper bioavailability provide a reasonable conceptual framework for improved descriptions of how copper toxicity differs across exposure conditions.

Appendix B. Estimated Range of Atlantic Sturgeon Distinct Population Segments (DPSs)



Atlantic Sturgeon Estimated Range for Five DPSs

Inland Range (displayed by HUC10 watershed unit)

Accessible Waterways*

Major Tidal River Accessible to Sturgeon

Spawning Documented

Impassable Dam

*Accessible habitat for any DPS of Atlantic sturgeon is defined as <u>in-water</u> habitat located in marine or estuarine areas below the high tide line, or in riverine areas below the high water line.

Appendix C. Estimated Range of Sea Turtles

Estimated Range of Sea Turtles